VII. PRETREATMENT REQUIREMENTS

Pretreatment of the influent waste water can significantly increase filtration efficiency. Pretreatment can be particularly important in treating hazardous and toxic waste water streams. For example, gravity separation or dissolved air flotation may need to be used when two-phase liquid wastes (e.g., petroleum hydrocarbons and water) are present; chemical pretreatment may be required where emulsions are present; or sedimentation may be necessary where total suspended solids concentrations are prohibitively high. Pretreatment may include oxidation of soluble forms of reduced metals, reduction of suspended solids by chemical flocculation and sedimentation, chemical precipitation of dissolved metals or other dissolved ions such as phosphorous, or coagulation by addition of chemical filtration aids, such as poly-electrolytes. Where pretreatment is used to enhance the filtration process, the designer should keep in mind that the pretreatment must not be designed independently from the filtration system, since the pretreatment facilities will depend on the type of filtration system selected. Also, where direct discharge to surface water is anticipated, water quality standards must be considered (e.g., for aluminum or iron).

Laboratory studies are generally required to determine type and degree of pretreatment. These studies may range from simple jar-tests to column studies to plant studies on the actual filters. It is necessary to determine the most effective pretreatment method and dosage to maximize filtration operation. Pretreating the influent too extensively may result in increased filter clogging and shorter filter runs. This is particularly the case when polyelectrolytes are overdosed, blinding the media.

Alum has traditionally been used in filtration as a coagulant to produce a heavier floc with greater settling velocities. More recently, cationic polymers have been used alone or in combination with alum or clay. Studies have shown polymer coagulation is more effective and problem-free than alum coagulation. When using alum (versus polymers), the operator generally must add lime for pH adjustment. Also, alum is more difficult to use than polymers since various polymer combinations can be tolerated without significant effect on effluent turbidity. Additionally, the polymer floc is significantly more resistant to shear than the more fragile alum floc. The alum floc tends to trap water, which may result in dewatering problems. When using polymers, though, surface wash is strongly recommended.

Ferric chloride is also commonly used as a coagulant. Metal salts such as ferric chloride can be used to precipitate phosphorous from waste streams. These fine floc particles do not necessarily settle well and filtration may be the only process to meet stringent phosphorous limitations. One danger of using ferric chloride is during groundwater re-injection since iron tends to precipitate at the well screen, thereby affecting the capacity to re-inject water.

Polymers or alum may be rapidly mixed with the water directly before the filtration process, eliminating the need for prolonged sedimentation. Flocculation periods may be short with high intensity flocculation or somewhat longer flocculation periods with less intense mixing. This process is referred to as direct filtration. Usually direct filtration is used with dual media and multi-media filters. Single media filters can not handle the high solid loading which occurs with direct filtration. A greater degree of purification, e.g., sedimentation, must be performed before introduction of the waste stream to the single media filter. However, too high a solids loading will clog any filter. overdosing of polymer can "blind" the bed. Charge destabilization (i.e., destabilizing the charge of the particle so that the particles will coagulate) is the mechanism by which a polymer coagulates. Once charge destabilization is accomplished, excess polymer will unnecessarily add to solids loading. This will result in significant head loss since a greater quantity of solids need to be removed from the influent stream. Alum, on the other hand, is more forgiving for variable source particle loadings.

Direct filtration is generally used with dual media filters. When contaminants are soluble and can be precipitated to form floc particles, direct filtration may be applicable. In direct filtration, the water is subjected to rapid mixing and flocculation, followed directly by filtration. Direct filtration can be used only when floc formation can occur quickly. In some instances, flocculating periods as short as three minutes are used. Flocculation is conducted in a static in-line mixer, eliminating the need for rapid mix tanks. The designer must design the system considering adequate flocculation times.

Systems filtering physical-chemical flocs tend to use lower filter rates and finer media than those filtering biological floc. This may be because biological flocs tend to be stronger and more resistant to shear than chemical flocs. But, because of the strength and character of the biological floc, greater surface filtration occurs, resulting in excessive head loss since the floc does not penetrate the bed. Polymer filter aids may be added to the filter influent to strengthen weak chemical flocs, to permit higher flow rates, but backwash rates, surface wash, and/or air scour may be needed due to higher attachment forces to the media.

Reference. See Appendix D.